USING A NOVEL INTERVENTION TECHNIQUE TO REDUCE THE VARIABILITY AND IMPROVE TENDERNESS OF BEEF *LONGISSIMUS DORSI*

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Background

A major reason for the variability in beef eating quality is the non-uniform nature of the carcass. Up until the time of rigor muscles within the carcass experience different pre-rigor profiles of temperature, pH and contraction and these variables have profound effects on eating quality.

Various techniques such as electrical stimulation and aitch bone hanging have been employed at industry level in attempt to reduce variation, theses treatments have been applied to the whole carcass and while these interventions significantly improve tenderness the effect is not uniform throughout the carcass. Aitch bone hanging tenderises the striploin and topside, but toughens the fillet and has little effect on forequarter muscles (Troy, 1999).

If muscles are hot-boned (excised immediately after slaughter) optimum treatment can be established for individual cuts in the early post mortem period. Other advantages of hot-boning include reduced weight loss, reduced drip, lower chilling costs and a more uniform chilling rate. In addition due to the higher pH and level of ATP, better solubility of myofibriallar proteins and dissociation of actomyosin the functional properties of hot boned meat are superior to cold boned meat (Pisula and Tyburcy 1996). However there are two major disadvantages of hot-boning; increased toughening when chilled quickly (due to excessive shortening of free muscle as compared with partially restrained muscle in a carcass) and shape distortion.

Objectives

To reduce variability and improve the tenderness of hot-boned *longissimus dorsi* muscle using different forms of artificial restraint

Materials and methods

Hereford Cross Friesian heifers were slaughtered at the research abattoir in The National Food Centre, Dublin. Hot-boned *longissimus dorsi* muscles (excised within 90 mins *postmortem)* were subjected to artificial restraint. Muscles were randomly assigned to the following treatments: "weights" (4 kg weight suspended form a hanging muscle), "Pi-Vac" (packed in a novel packaging machine Pi-Vac which uses film of high degree elasticity to prevent contraction of the hot boned muscle) and control (no restraint applied to the muscle). The hot boned muscles were chilled at 2°C until 48hr *postmortem.* At 48 hr post mortem all samples were vacuum packed and aged for 14 days. The rate of pH decline and temperature was monitored up to 2 days *post mortem.* Warner Bratzler shear force was measured at 7 and 14 days *postmortem.* Drip loss and sarcomere length was measured at 2 days *post mortem.* Colour and sensory analysis was carried out after 14 days ageing.

Results and Discussion

Muscles stretched by weights or packaged using the Pi-Vac technique had significantly ($p<0.05$) lower Warner Bratzler shear force (WBSF) values (were more tender) than control muscles after 7 and 14 days ageing (Fig.1). On a scale of 1-8 for tenderness, weighted or Pi-Vac muscles were ranked higher than control muscles by a trained sensory panel (Fig. 2). Sarcomere length was significantly ($p<0.05$) shorter for the control muscle (1.34μm) compared to the weighted and Pi-Vac muscles (1.64μm and 1.63μm respectively). Redness values (Hunter "a") after 14 days decreased in the order: Pi-Vac (14.96)>Weight (14.37)>Control>(14.22). Drip loss was also significantly lower for the Pi-Vac samples (Fig 4) and the shape of the muscle not distorted as the pre-rigor meat formed into the shape of its constraining pack.

The results of this study are in agreement with (Wahlgren and Hildrum 2001) who showed that Pi-Vac increased the tenderness of *longissimus* muscles and that it was possible to chill these muscles rapidly without detrimental effects on tenderness. Reducing variability and producing a more consistent product is of primary concern in the beef industry today. An important finding in this study was that Pi-Vac produced a more consistent product with very little variability compared to the other two treatments (Fig 3).

Conclusions

A novel packaging technique Pi-Vac allows hot-boned meat to be chilled quickly without adversely affecting the tenderness. This system produces a consistent quality product with lower drip loss and improved shape. Using this system will allow individual muscles throughout the carcass to be treated optimally.

Pertinent Literature

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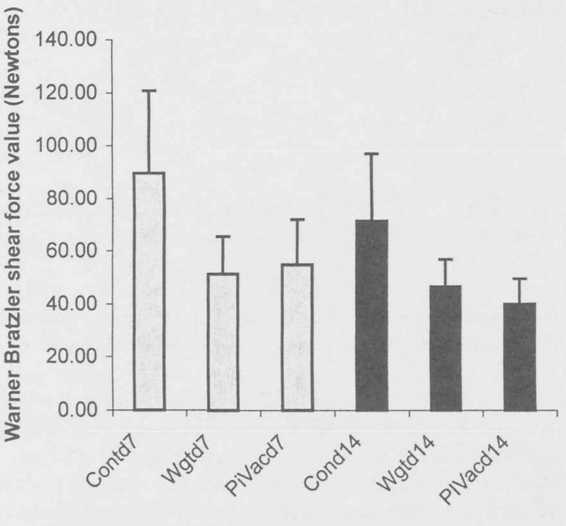


Fig.1 WBSF values at 7 and 14d ageing

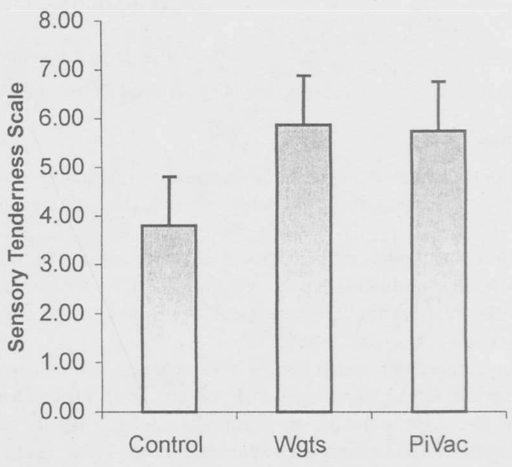
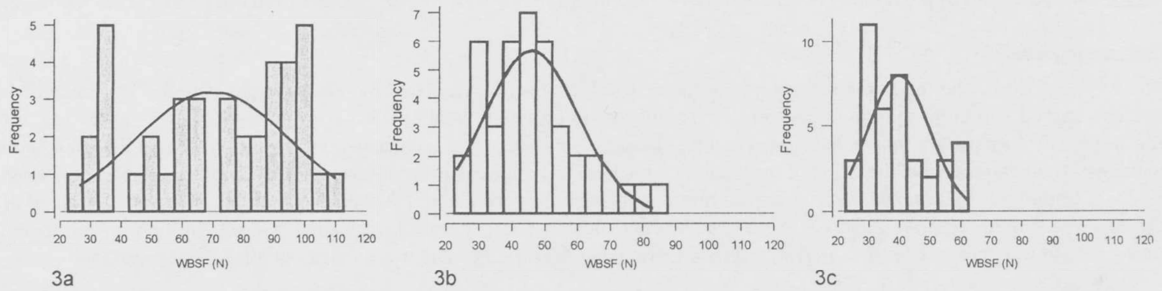


Fig.2 Sensory tenderness scores



3a 3b 3c

Fig.3 Variability in WBSF (day 14) in a. Control b. Weights and c. Pi-Vac samples

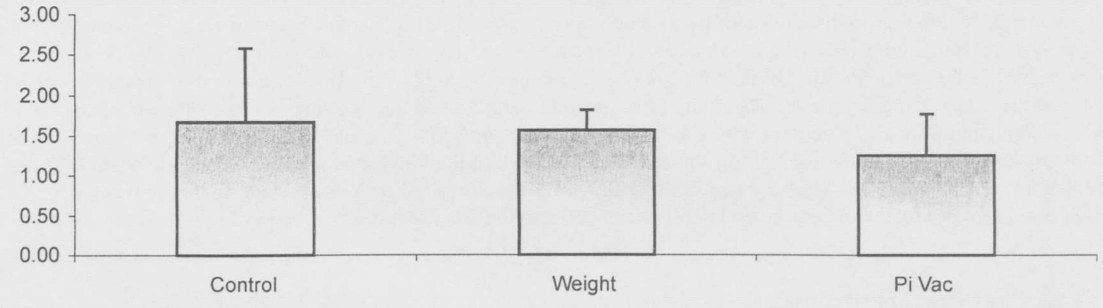


Fig.4 %Drip Loss

THE EFFECT OF SEX , DIETARY PROTEIN AND ENERGY LEVELS ON QUAIL CARCASS COMPOSITION

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Background

The use of quail meat for food is becoming increasingly important in many countries. Although broiler and turkey carcass characteristics are now receiving considerable attention and have been extensively studied (Moran, 1977; Jackson et al., 1982; Leeson and Summers, 1980; Leeson et al., 1996; Orr et al.,1984) little information has been reported on those of the quail carcass (Edwards, 1981; Caron et al. 1990; Marks, 1993; Toelle et al., 1991).

Many factors affect the quality of the carcass including age, sex, genotype, brooding temperature and diet (Moran, 1977). According to Leeson & Summers (1997) while carcass yield is largely a factor of age and genetics, carcass composition can to a large extent be modified trough diet choice. It is known that diets high in energy produce fatter carcasses in broilers and vice versa. On the other hand, high protein diets produce broilers with leaner carcasses. The balance of protein to energy is quite important and broilers fed high protein diets tended to show leaner carcasses due to less fat deposition rather than to higher protein deposition (Leeson & Summers, 1997). However, Kirkpinar & Oguz (1995) studying the effect of dietary protein varying from 160 to 300 g/kg in isocaloric diets found that carcass protein content increased with higher dietary protein. Carcasses with the highest fat content were obtained from quails receiving the low protein diet. Edwards (1981) studying carcass composition of an unselected population of quails reported that the water content of the carcass decreased as the concentration of protein in the diet increased and the birds aged, whereas the carcass protein content increased with dietary protein and age. Carcass ash content did not change with age or diet, whereas the carcass fat content increased with age.

Objectives

The objective of the present study was to evaluate the influence of the sex and diets containing different protein and energy levels on carcass yield and composition of Italian quails for meat production.

Methods

768 one-day-old Italian quails, were reared during 42 days on floor. They were distributed in 48 groups of 16 birds, being 8 males and 8 females each. The experimental design was completely randomized in a factorial arrangement with 16 treatments including 4 levels of protein and 4 levels of metabolizable energy and 3 repetitions per treatment.

At the end of the experimental period six males and six females from each treatment (192 birds) were fastened for 4 hours, individually weighed, slaughtered (CO_2 stunning and bleeding), plucked and eviscerated. Carcasses were then weighed to determine carcass yield, individually packaged in polyethylene sacs and frozen at –20 ºC.

Proximal composition including moisture, fat, protein and ash were determined according to AOAC (1990) in samples prepared by grinding (5mm plate) 2 female carcasses and 2 male carcasses per repetition.

Data were subjected to analysis of variance by the General Linear Models procedures of SAS Institute (1990). Differences among means were determined by SNK test (Sampaio, 2000) with significance at $P< 0.05$.

Results and Discussion

Changes in dietary protein and energy levels (Tables 1 and 2, respectively) altered significantly ($P<0,05$) carcass composition. However sex affected just carcass yield (Table 3). Males had a higher percentage of carcass yield than females.

Protein and ash content of Italian quail carcasses were not affected by protein and energy levels of the diets. According to Leeson & Summers (1997) for broilers diet protein has no effect on the quantity of protein deposited in the carcass, except when very low protein diets are used. Contrary to these results Edwards (1981) and Kirkpinar & Oguz (1995) found an increase in quail carcass protein and ash content as the level of dietary protein increased.

Carcass moisture content was influenced by dietary protein and energy levels, increasing in a quadratic manner as the protein level increased. Moisture content reached a maximum point at the level of 23,39% of crude protein and after this point it decreased. However carcass moisture content showed a linear relationship with dietary energy levels, with water content decreasing as the energy level increased.

The fat content of quail carcass was affected linearly by dietary energy. As the dietary energy level changed from 2,700 to 3,150 kcal ME/kg the content of fat in carcass increased. Seaton et al. (1978) observed an increase in carcass fat and a decrease in carcass moisture of broilers with an increase in the dietary energy level while carcass protein was unaffected. These results are in according to those obtained in this trial using quails for meat. Also, Leeson & Summers (1997) stated that with low energy diets leaner broilers can be produced by reducing fatness, rather than by increasing lean meat deposition.

Conclusions

Quail carcass yield was affected by sex, but not by the dietary protein and energy levels studied.

Carcass fat content increased and carcass moisture decreased as the energy level of diets increased.

The increase in carcass moisture related in a quadratic manner with the increase in dietary protein levels.

Dietary protein and energy levels used in this study did not affect carcass protein and ash contents of Italian quail meat

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Table 1. Effect of dietary protein levels on carcass yield and composition of Italian quail[1].

Dietary Protein (%)	Carcass yield (% LW)	Carcass moisture (%)	Carcass fat (%)	Carcass protein (%)	Carcass ash (%)
20	$79.03^a \pm 4.38$	$62.72^b \pm 3.12$	$17.66^a \pm 3.96$	$16.16^a \pm 0.78$	$2.71^a \pm 0.30$
22	$77.57^a \pm 4.37$	$64.49^a \pm 1.81$	$15.90^a \pm 2.41$	$16.61^a \pm 0.77$	$2.86^a \pm 0.28$
24	$78.46^a \pm 4.50$	$64.85^a \pm 2.75$	$15.62^a \pm 2.92$	$16.65^a \pm 0.95$	$2.74^a \pm 0.29$
26	$77.55^a \pm 4.64$	$63.57^{ab} \pm 1.94$	$16.54^a \pm 2.25$	$16.44^a \pm 1.18$	$2.66^a \pm 0.26$

[1] Mean values in column with no common superscripts differ significantly (P<0.05)

Table 2. Effect of metabolizable energy levels on carcass yield and composition of Italian quail[1].

Dietary Metab. Energy (kcal ME/kg)	Carcass yield (% LW)	Carcass moisture (%)	Carcass fat (%)	Carcass protein (%)	Carcass ash (%)
2700	$78.35^a \pm 4.51$	$64.82^b \pm 1.81$	$15.12^b \pm 2.26$	$16.66^a \pm 1.15$	$2.69^a \pm 0.31$
2850	$77.57^a \pm 4.71$	$64.49^a \pm 2.79$	$15.99^{ab} \pm 2.88$	$16.73^a \pm 0.88$	$2.85^a \pm 0.29$
3000	$78.68^a \pm 4.37$	$63.29^a \pm 2.61$	$17.60^a \pm 2.98$	$16.09^a \pm 0.84$	$2.71^a \pm 0.26$
3150	$78.00^a \pm 4.39$	$63.04^a \pm 2.63$	$16.98^{ab} \pm 3.42$	$16.37^a \pm 0.76$	$2.72^a \pm 0.29$

[1] Mean values in column with no common superscripts differ significantly (P<0.05)

Table 3. Effect of sex on carcass yield and composition of Italian quail[1].

Sex	Carcass yield (% LW)	Carcass moisture (%)	Carcass fat (%)	Carcass protein (%)	Carcass ash (%)
Male	$81.13^a \pm 2.43$	$64.37^a \pm 2.35$	$15.90^a \pm 2.49$	$16.64^a \pm 0.87$	$2.79^a \pm 0.26$
Female	$75.17^b \pm 4.07$	$63.44^a \pm 2.71$	$16.96^a \pm 3.41$	$16.29^a \pm 0.99$	$2.69^a \pm 0.31$

[1] Mean values in column with no common superscripts differ significantly (P<0.05)

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